

t range to 400 μ V and is recom-
quiring high null resolution.
TCV_{OS} performance.

OLTAGE RANGE

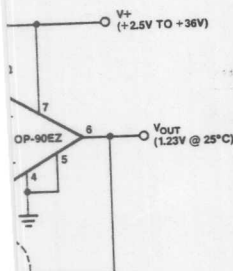
he OP-90's input and output
allows true "zero-in, zero-out"
rovides an active pull-down to
low this level, a load resistance
ired to pull the output down to

.8V the OP-90 has voltage gain
cation. Output current source
he entire voltage range includ-

GE REFERENCE

ry-powered voltage reference
y current. At this level, two AA
over 18 months. At an output
rift of the reference is only
mperature range. Load regula-
lation at 120 μ V/V.

ed on the bandgap technique,
produces unequal currents in
mismatch creates a tempera-
ss R3 which, in turn, produces
nal voltage across R4 and R5
output added to the V_{BE} of Q1
ture coefficient. Adjusting the
voltage Reference



REV. B

output to 1.23V at 25°C produces minimum drift over temper-
ature. Bandgap references can have start-up problems. With
no current in R1 and R2, the OP-90 is beyond its positive input
range limit and has an undefined output state. Shorting Pin 5
(an offset adjust pin) to ground forces the output high under
these conditions and insures reliable start-up without signifi-
cantly degrading the OP-90's offset drift.

SINGLE OP AMP FULL-WAVE RECTIFIER

Figure 5 shows a full-wave rectifier circuit that provides the
absolute value of input signals up to ± 2.5 V even though
operated from a single 5V supply. For negative inputs, the
amplifier acts as an unity gain inverter. Positive signals force
the op amp output to ground. The 1N914 diode becomes
reversed-biased and the signal passes through R1 and R2
to the output. Since output impedance is dependent on input
polarity, load impedances cause an asymmetric output. For
constant load impedances, this can be corrected by reducing
R2. Varying or heavy loads can be buffered by a second
OP-90. Figure 6 shows the output of the full-wave rectifier
with a 4V_{p-p}, 10Hz input signal.

FIGURE 5: Single Op-Amp Full Wave Rectifier

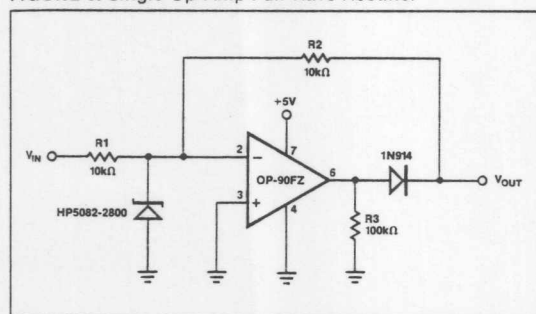


FIGURE 7: Two Wire 4-20mA Transmitter

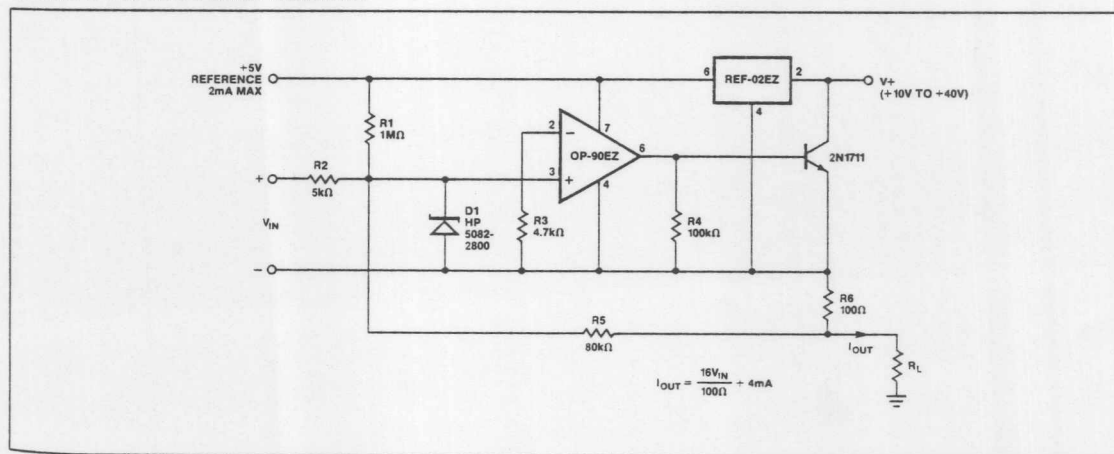
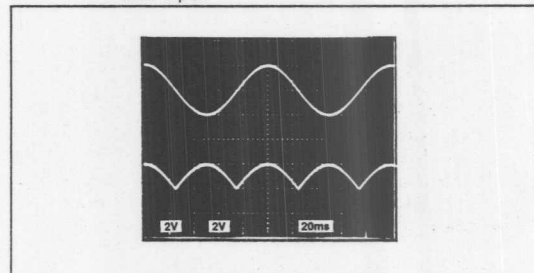


FIGURE 6: Output of Full-Wave Rectifier With 4V_{p-p},
10Hz Input



TWO WIRE 4-20mA CURRENT TRANSMITTER

The current transmitter of Figure 7 provides an output of 4mA
to 20mA that is linearly proportional to the input voltage.
Linearity of the transmitter exceeds 0.004% and line rejection
is 0.0005%/volt.

Biasing for the current transmitter is provided by the REF-
02EZ. The OP-90EZ regulates the output current to satisfy
the current summation at the noninverting node:

$$I_{OUT} = \frac{1}{R_6} \left(\frac{V_{IN} R_5}{R_2} + \frac{5V R_5}{R_1} \right)$$

For the values shown in Figure 7,

$$I_{OUT} = \left(\frac{16}{100\Omega} \right) V_{IN} + 4mA$$

giving a full-scale output of 20mA with a 100mV input.
Adjustment of R2 will provide an offset trim and adjustment of
R1 will provide a gain trim. These trims do not interact since
the noninverting input of the OP-90 is at virtual ground. The
Schottky diode, D1, prevents input voltage spikes from pull-